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**Reference**

Howard, G. 1969. Moths on Hoy, Orkney, June 1969. *Ent. Rec.*, **82**: 192.

## Dimorphism in *Papilio* Pupae

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(*concluded from Vol. 86, p. 272*)

analysis of the pupal colours in these: —

| | Green | Brown | Pink |
|---|---|---|---|
| *P. polytes* | 105 | 52 | — |
| *P. demoleus* | 105 | 13 | 6 |

In these figures I have not differentiated between the various shades of brown pupae, darker, paler or containing a certain amount of green, etc., but I have recorded the pink form of *demoleus* separately, a form which it shares with *demodocus* but is not found in *polytes*.

Finally, a short while ago, I received through the kindness of Professor Clarke a copy of a paper (West, Snellings & Herbek, 1972) describing experiments with the American *P. polyxenes asterius* Stoll., establishing a definite relationship between the day/night ratio and the colour of the pupa, long day/short night (i.e. non-diapausing) pupae being mostly green and short day/long night (i.e. overwintering) pupae being brown, regardless of background, but non-diapausing pupae showed a certain flexibility, the colour being affected by the colour of the background and the light reaching the ventral surface of the pharate pupa. It was also noted that, whilst diapausing pupae were very uniform in tint, there was considerable difference in the shade of brown in non-diapausing pupae.

It is not, I think, unreasonable to assume that: —

1. The chemical difference between the green and brown forms of all dimorphic *Papilio* pupae is the absence or presence of melanin, and,
2. That the production of the melanin is triggered off by Hidaka's hormone.

The question to determine is what is the stimulus required to activate the various ganglions and produce the hormone.

Clarke & Sheppard found no indication of a genetical factor when working with *polytes*, but I cannot help feeling that a situation in which there were three genotypes, a definite green, a definite brown and an optional green/brown, would be almost impossible to detect satistically. A definite green or brown pupa, controlled genetically, could be a serious dis-

advantage to a species if the inherited colour was not combined with an inherited preference for suitable pupating sites.

It is difficult to see how the day/night ratio can affect tropical species, where there is very little difference in length between the longest and the shortest day. Diapause seems to be quite haphazard in tropical *Papilio* species and, seeing that most species feed on evergreen trees and shrubs, the value of a brown diapausing pupa is much reduced.

In my *demodocus* experiment, all factors were constant, except the actual nature of the surface on which the pupa was formed. The colour was the same, whether rough or smooth, and the pupating jar was in virtual darkness in a closed wooden box. There was, however, a complete absence of green pupae from larvae that had been reared in more or less crowded conditions. If movement does tend to produce brown pupae, it would provide an explanation for what Clarke & Sheppard term "mistakes", i.e. mismatched pupae, as these could be explained by a larva that had travelled a long distance, and still finished up among leaves and produced a brown pupa, or one that had only wandered a short way and finished up on a tree trunk and produced a green pupa. It is possible that larvae that produce over-wintering pupae in temperate zones travel further than the summer larvae which are not going to produce diapausing pupae.

West, in a personal communication, has suggested that the stimulus may vary from species to species, and even between different populations of the same species, but attractive as this suggestion may appear, I am reluctant to accept it.

## References

Poulton, E. B. (1892). Further experiments upon the colour-relations between certain lepidopterous larvae, pupae, cocoons and imagines and their surroundings. *Trans. Ent. Soc. Lond.*, **1892**: 293-487.

Hidaka, Toshitaka. (1956). Recherches sur le Déterminisme Hormonal de la Coloration Pupale chez Lépidoptères 1. Les Effets de la Ligature, de l'Ablation des Ganglions et de l'Incision des Nerfs chez Prépupes et Larves agées de quelque Papilionides. *Annotationes Zoologicae Japonenses*, 29, No. 2: 69-74.

Sevastopulo, D. G. (1948). The Colour Relationship between certain Pupae and their Surroundings. *Proc. R. ent. Soc. Lond.*, (A), **23**: 93-95.

Oldroyd, S. Margaret. (1971). Biochemical Investigation on Various Forms of some *Papilio* species. *Entomologist*, **104**: 111-123.

Owen, D. F. (1971). Pupal Colour in *Papilio demodocus* (Papilionidae) in Relation to the Seasons of the Year. *Journ. Lepid. Soc.*, **25**: 271-274.

Clarke, C. A. and Sheppard, P. M. (1972). Genetic and Environmental factors influencing pupal colour in the swallowtail butterflies *Battus philenor* (L.) and *Papilio polytes* L. *J. Ent.* (A), **46**: 123-133.

West, David A., Snellings, William M. and Herbek, Thomas A. (1972). Pupal Colour Dimorphism and its Environmental Control in *Papilio polyxenes asterius* Stoll. (Lepidoptera, Papilionidae). *Journal of the New York Entomological Society*, LXXX, No. 4: 205-211.